The NGNGV Program Update

Feature: Summary of the Working Group Meeting, Nov. 7-8, 2000, Dallas, TX

The NGNGV Program Update newsletter is available on the web site of the Next Generation Natural Gas Vehicle Program at www.ctts.nrel.gov/ngngv.

Welcome…

This first issue of the *NGNGV Program Update* provides background information about the program, its purpose, strategy, and structure. The newsletter also will keep you updated on the program's meetings and progress. This issue features news on the program's Working Group meeting held in Dallas, Texas on November 7 and 8, 2000.

What is the NGNGV Program?

The steady increase in the number of vehicles on our roads and in the number of miles driven is escalating the demand for oil imports and is contributing to the degradation of air quality. Responding to these concerns, the U.S. Department of Energy (DOE), Office of Transportation Technologies (OTT) has identified the development of next-generation natural gas vehicles as one part of its strategy to reduce oil imports and vehicle pollutants. Natural gas is a clean-burning, abundant, domestically available fossil fuel that also is a promising alternative vehicle fuel in terms of cost-competitiveness, vehicle performance, and low emissions of regulated pollutants.

Program Mission – Because medium- and heavy-duty vehicles burn more fuel and emit more pollution per mile than other vehicles, the Next-Generation Natural Gas Vehicle Program was formed to develop commercially viable medium- and heavy-duty natural gas vehicles.

Program Goals – Develop one new medium-duty (Class 3-6) compressed natural gas (CNG) vehicle and one new heavy-duty (Class 7-8) liquefied natural gas (LNG) vehicle by 2004 that:

- Advance the DOE natural gas and heavy-vehicle technologies
- Implement advanced engine technology
- Have NOx emissions below 0.5 g/bhp-hr and PM emissions below 0.01 g/bhp-hr, significantly below EPA emissions standards for 2004
- Represent a significant step-change in natural gas vehicle technology
- Are competitive with diesel vehicles in performance and life-cycle costs
- Are technically and commercially viable
- Aid Nonattainment Areas in reducing pollutant emissions from vehicles.

Program Strategy – Commercial success of these natural gas vehicles will require that the vehicles be economically attractive, have a broad customer base, and be supported by a stable fueling and maintenance infrastructure. The development of these vehicles is based on a three-element strategy involving active participation by key stakeholders:

- **Build industry and market support**.
- **Design, develop, and evaluate prototype vehicles with the support of an advisory Working Group.** The Working Group or "NGNGV-WG" consists of key representatives from the natural gas industry, original equipment manufacturers and suppliers, national laboratories, government agencies, and other stakeholders.
- **Coordinate enhancement of the fueling and maintenance infrastructure.**

To obtain more detailed information about the program and to add your name to the program information distribution list, visit www.ctts.nrel.gov/ngngv.

Summary of the NGNGV Working Group Meeting

Nov. 7-8, 2000 — Dallas, Texas

The goal and vision for the government-industry Next Generation Natural Gas Vehicle Program is to develop two commercially viable natural gas vehicles by 2004, a medium-duty (Class 3-6) compressed natural gas (CNG) vehicle and a heavy-duty (Class 7-8) liquefied natural gas (LNG) vehicle. The purpose of the NGNGV Working Group (NGNGV-WG) is to advise DOE and its funding partners in the development of these vehicles and accomplishment of program goals.

Nov. 7-8 NGNGV-WG Participants: John Dimmick, Brian Stokes, Ralph Nine, Lizabeth Adrisna, Brian Pepper, John Kubesh, Bill Ryan, Jim Mayfield, Bill Horrell, Mark Green, Mike Bogdanoff, Kevin Chandler, Robb Barnitt, Michael Clark, Mike Frailey, Robert Mitchell, Kevin Stork, Louis Lautman, Hank Seiff, Denny Stephens, Jennifer Elling, Paul Norton, Elizabeth Dolan.

Program Overview and Meeting Purpose

Paul Norton, the Program Manager from NREL, opened the meeting by welcoming Working Group participants, providing a brief program overview, and reviewing the meeting objectives and agenda. His presentation can be found at the NGNGV website at www.ctts.nrel.gov/ngngv/events.

The goal and vision for this program is that one medium-duty (Class 3-6) CNG vehicle and one heavy-duty (Class 7-8) LNG vehicle will be available in 2004 that:

- Implement advanced DOE natural gas and heavy-vehicle technologies
- Implement high-efficiency engine technology
- Implement a step-change in technology over current NG vehicles
- Have NOx emissions below 0.5 g/bhp-hr with a stretch goal of 0.2 g/bhp-hr, and PM emissions below 0.01 g/bhp-hr
- Are fully competitive with diesel vehicle counterparts in terms of performance and life-cycle economics
- Are commercially viable

Two rounds of research are planned in the program: (1) Completion of Enabling Technologies and (2) Prototype Vehicle Development. The first will focus on completing research on and beginning commercialization of enabling technologies. These are technologies that

- Are close to completion
- Could be completed with a relatively short, focused research effort
- Could be made commercially viable in the 2004 time frame
- Overcome current barriers to natural gas vehicle introduction.

Round 2 of the program will fund the development of two prototype vehicles to be put in service in on-road development in 2004.

The primary objective of the November 7 and 8 meeting was to decide which technologies should be pursued in NGNGV Program Round 1 of research. Paul pointed out that participants in prior meetings and workshops have recommended that a primary focus of technology development should be to reduce the cost of natural gas vehicles and make them more competitive.

Paul next discussed program goals and potential program challenges. Working Group members asked how the NGNGV program integrates with the 21st Century Truck Program. Paul responded that the 21st century truck

will likely focus on hybrid electric vehicle development, so the two programs don't overlap. The NGNGV Program is currently separate and distinct from the 21st Century Truck Program.

Two of the program goals, emissions standards and diesel competitiveness, were discussed briefly. All agreed that these goals are ambitious and challenging. This subject was discussed in more detail later in the meeting.

Overview of Results from Previous NGNGV Workshops and Meetings

Denny Stephens, the Deputy Program Manager from Battelle, presented the results of the NGNGV Workshop held in Chicago on May 2 and 3, 2000 and of other stakeholder workshops around the country. This presentation, including more detailed results of the May 2 and 3 NGNGV Workshop, can be found at the NGNGV web site at www.ctts.nrel.gov/ngngv/events. In the May workshop, Working Group participants divided into four groups to provide recommendations for the program on:

- Vehicle types and markets
- Natural gas engine technologies
- Vehicle fuel system and storage technologies
- Body and chassis technologies

The groups rotated such that everyone had input to each topic. The recommendations were then organized and categorized by participants. All participants voted to identify most critical issues and technologies. The participants in that workshop suggested by their votes that the most needed medium-duty natural gas vehicles were delivery vehicles and paratransit and small buses. The most needed heavy-duty vehicles according to the working group are in-city route trucks (such as a short-haul day cab for regional delivery and Class 7-8 refuse truck) and an over-the-road tractor. Results from the other groups are found in Denny's presentation.

Analysis of Data and Recommendations for Round 1 RFP

As discussed earlier, the program has been planned to have two rounds of research (1) Completion of Enabling Technologies and (2) Prototype Vehicle Development. The objective of the remainder of the meeting was to determine which enabling technologies were needed for successful NGNGV development, but which were not in progress under another government or industry program, and which should be pursued in Round 1. Paul Norton led this portion of the meeting. Paul began with a discussion of the vehicles to be developed. The result of brainstorming and voting exercises in previous meetings was the recommendation for a

- Package delivery truck as the medium-duty CNG vehicle
- Class 7 or 8 refuse hauler as the heavy-duty LNG vehicle.

The Working Group discussed these objectives at length. In both cases, the Working Group expressed concerns that many variables influence which vehicles will be commercially viable and successful. The group suggested that serious research is needed in Round 1 to gain a better understanding of customer demand for a specific type of vehicle chassis and other design demands and the incentive packages that could ensure the cost-competitiveness of the vehicles. The Working Group suggested that engine and chassis original equipment manufacturers (OEMs) may have better information concerning the relative commercial merits of these vehicles, and that they may be better suited to select the most viable vehicles to pursue.

Under Paul Norton's guidance, the Working Group reviewed and discussed the program's emissions objectives. At the time of program initiation, it was expected that EPA's 2007 emissions goals would be 0.5 g/bhp-hr NOx and 0.01 g/bhp-hr particulate mater (PM). With this expectation, the Working Group had adopted these levels as the emission targets for the program at its May meeting. However, it appeared in November that EPA would

adopt a lower requirement for NOx of 0.2 g/bhp-hr*. The Working Group discussed whether the goal should be reduced to this lower level. Participants noted that such a low reduction would likely decrease efficiency of natural gas engines, which are already less efficient than their diesel counterparts. Implementation of the 0.2 g/bhp-hr emission level before it was required in 2007 could result in an uncompetitive vehicle with few customers. After serious discussion, the Working Group recommended that the program goal for NOx should be a minimum of 0.5 g/bhp-hr and the stretch goal should be 0.2 g/bhp-hr. The goal for PM should be 0.01 g/bhp-hr.

The Working Group discussed the meaning of the program objective term "commercially viable." The Working Group recommended that commercial viability should imply production and sales volume greater than 1000 vehicles.

The discussion of the program objectives concluded with a discussion of priorities. The Working Group recommended the program leadership adopt the following priorities.

1. Meet an emissions standard of 0.5 g/bhp-hr NOx and a stretch goal of 0.2 g/bhp-hr
2. Implement technology that has been funded by DOE
3. Focus on commercially viable technology by:
    - Targeting the customer
    - Marketing for sales volumes in the 1000's of vehicles
    - Putting the premium on life-cycle economics
    - Targeting geographical areas via mandates, incentives, and emissions trading.

Paul next explained that, to decide on the technologies to be implemented in Round 1, the Leadership and Working Group must go through a filter-based decision process. To expedite the decisions, the Leadership has developed the first iteration and straw recommendations for review, discussion, and modification by Working Group. Paul recommended the following process:

- Begin with top recommendations from the Working Group
- Pass all data through filtering questions to reduce the number of technologies.
- Post all reasoning on the walls
- Open discussion with all participants
- Vote on vehicle type and technologies
- Write up recommendations of the group for the funding partners

With the Working Group's agreement, Paul described the filtering and reasoning process. This presentation can be found at the NGNGV web site at www.ctts.nrel.gov/ngngv/events.

The filtering process and Working Group discussion resulted in the following list of 11 potential technologies that could need further investigation.

LNG Fuel System Technologies

1. Standard LNG receptacle
2. Low cost LNG tanks
3. LNG system design integration
4. LNG fuel gauge
5. Crash protection for LNG tank
6. LNG tank defueling

* In December 2000 EPA finalized its emissions standards for 2007, requiring NOx emissions of 0.5 g/bhp-hr or less.

Engine Emissions and Aftertreatment

7. Natural gas engine to meet NGNGV goals
8. Lean NOx aftertreatment
9. Total hydrocarbon reduction
10. Oxidation catalyst

Other

11. Continually variable transmission for CNG truck.

Paul explained that funding for this phase of the program is estimated to be at $1.45 to $2.45 million, which is not sufficient to fund all of these technologies in Round 1. He asked the participants to review this list and vote on those topics that are most critical to the success of the NGNGV program. This exercise using adhesive dots resulted in the following top three recommendations:

- Natural gas engine to meet NGNGV goals (36%)
- LNG system design integration (18%)
- Lean NOx aftertreatment (18%)

The remaining topics each received 9 percent or less of the vote. The Working Group confirmed this vote with an up or down confirmation. It agreed that natural gas engine and emissions control technologies, including aftertreatment, were the highest priorities.

As the Working Group reviewed the topic of enabling technologies and discussed its recommendations for Round 1 RFPs, it expressed concerns that

- The project will lose valuable time if it waits until the conclusion of Round 1 to begin vehicle development
- Chassis OEMs may be better suited to recommend the most commercially viable vehicles for development in the NGNGV program.

It was the opinion of the Working Group that the same parties who must make the ultimate commitment to build and market the vehicles are the parties best equipped to decide where investment in new vehicle development should be made. As this discussion evolved, the Working Group recommended that vehicle design be included as part of the Round 1 research efforts. It was suggested that Round 1 include an opportunity for teams, led by chassis OEMs, to develop preliminary designs for natural gas vehicles which meet the objectives of the NGNGV program. Because of the short time frame for vehicle development, the NGNGV Working Group recommended that NREL and its funding partners initiate two parallel tasks in the Round 1 RFP:

- Task A: Assess technologies and methods for controlling emissions of natural gas engines, including technologies such as enhanced combustion, emission control and/or aftertreatment. Develop a strategy for achieving 0.5 g/bhp-hr or lower NOx emissions in natural gas engine products with the intent of implementing this strategy in the Next Generation Natural Gas Vehicle Program by 2004.
- Task B: Develop preliminary designs and market introduction strategies for medium-duty CNG and heavy-duty LNG vehicles meeting the goals and objectives of the NGNGV program.

Although the effort in Round 2 prototype vehicle development must have fully integrated engine and vehicle development, the NGNGV Working Group recommended that the emissions control technologies assessed in Round 1 not be applied to specific engines and vehicles at this time, with the possible exception of gasoline-based engines. The Working Group also recommended that respondents be permitted to submit proposals for either or both Phase I tasks. Teaming should be encouraged wherever appropriate.

NREL and the project leadership indicated it would adopt this recommendation and move forward with a two-part RFP. At the request of NREL, a number of participants agreed to participate in ad hoc task forces to develop more specific recommendations on each of the Round 1 Tasks to aid NREL in developing an RFP.

Communications and Outreach

Jennifer Elling, communicator from NREL, and Denny Stephens presented the external and internal strategies and tools for the program communications. A survey on communications needs was taken by the Working Group. The communications and outreach plans can be viewed at www.ctts.nrel.gov/ngngv/events.

Introduction of a New Industry Working Group for Natural Gas Vehicles

Denny Stephens led the introduction of a new Working Group being formed by the Gas Technology Institute and the Technology Committee of the Natural Gas Vehicle Coalition. Similar to the Infrastructure Working Group, the mission of this working group will be to develop strategies and programs for overcoming technical obstacles to a sustainable natural gas vehicle market. Where the NGNGV Working Group is focused on development of two specific vehicles, the Vehicle Working Group will address a wide variety of topics, including near-term problems that are preventing the effective deployment of NGVs. Louis Lautman of the Gas Technology Institute and Brian Stokes of PG&E and the Chair of the NGVC Technology Committee each shared their insights concerning this new working group and its value to the industry. This new group is expected to be of interest to the same people and companies participating in the NGNGV program. The first meeting of this new Vehicle Working Group will be held in conjunction with the next NGNGV Working Group meeting.

Paul Norton and Denny Stephens closed the meeting with the announcement of the next NGNGV Program meeting for the Working Group and Leadership Team, which is scheduled for March 12, 2001 Los Angeles, CA. This meeting will focus on updating the Working Group recommendations for the program based on the latest developments in DOE technologies and in DOE natural gas vehicle program strategy. Paul Norton also announced that he is moving to a different division within NREL to work on energy efficient homes and buildings. He will continue to manage the NGNGV program through the March meeting, at which time a new manager from NREL will take over.

* This publication is sent to the NGNGV Program Working Group, Leadership Team, and other interested parties. If you would like to be added to the distribution list for this newsletter or have comments, suggestions, or corrections to this newsletter, please contact Jennifer Elling at NREL by email jennifer_elling@nrel.gov or by phone (303) 275-3803.